DEPARTMENT OF THE AIR FORCE
HQ AIR FORCE SPECIAL PROJECTS PRODUCTION FACILITY (AFSC)
WESTOVER AIR FORCE BASE, MASSACHUSETTS 01022

REPLY TO ATTN OF: RD [redacted] 5 OCT 1972 STAT

SUBJECT: T&E Report, [redacted] Type SO-500 Material STAT

TO: [redacted] STAT

Attached for your information and retention is one copy of Preliminary Test and Evaluation Report on [redacted] Type SO-500 Material. STAT

[redacted] STAT

Director of Research & Development

1 Atch
T&E Report as stated

FOR OFFICIAL USE ONLY

PRELIMINARY TEST AND EVALUATION REPORT

[redacted] SO-500 STAT

CONDUCTED BY

DIRECTORATE OF RESEARCH AND DEVELOPMENT

HQ AFSPPF

September 1972

A. INTRODUCTION:

1. A preliminary evaluation of [redacted] material, Type SO-500, was performed by AFSPPF. The purpose of the test was to determine if this material would show significant improvement over the previous lots tested and to compare the results with standard duplicating material SO-192. STAT

2. The characteristics identified for immediate evaluation were relative sensitometry (sensitivity, exposure range, and density reproduction range), resolution retention, and image coloration.

B. TESTS CONDUCTED:

1. [redacted] delivered to AFSPPF a printer designated PHP-C1 and a processor, PHF-C1, to be utilized in evaluating their material, SO-500. Continuous printing exposures were made on SO-500 on the PHP-C1 using two 1 KW Mercury Gallium Indium-doped Lamps. STAT

2. Modulation was provided by a 21-step tablet and a series of USAF 1951 Bar Targets reproduced on 3414 original negative stock. To permit system comparisons, the same tablet and targets were duplicated in the production environment onto SO-192 stock. Comparative printing conditions and parameters were:

	SO-500	SO-192
Printer -	PHP-C1	Production Niagara
Lamp -	1 KW Mercury-Gallium Indium-doped (2)	400 W Mercury
Attenuator -	None	.40 Bias .80 ND Filter
Slit -	22 inches	2 inches
Print Speed -	5 FPM	100 FPM

3. Resolution comparisons were made by determining the optimum exposure vs resolution for each material SO-500 and SO-192, and performing multiple readings of the reproduced targets. The targets evaluated were T-3N at a 1.54:1 target object contrast (TOC) ratio and the T-4N at a 2.18:1 TOC. All readings, original, SO-192, and SO-500, were performed by RD personnel on an American Optical Company Spencer Microscope, No. 833212, at 100X magnification.

4. Processing of the SO-192 was accomplished in the Dalton production unit at normal system standards. The SO-500 was heat-processed at 160°C at 6 FPM in the PHF-C1 processor.

C. TEST RESULTS:

1. Analysis of the macrodensity characteristics (H&D) of the SO-500 indicates that the LogE range is approximately 2.00 under the parameters of this test series.

2. SO-500 is capable of providing a product density range of ≈1.7. The highest Dmax attained in the preliminary testing was approximately 2.0. B+F was .20 to .30 through a 3.0 wedge density.

3. Image color is blue with a purplish cast.

4. The results of the resolution comparison between SO-192 and SO-500 are as follows:

	SO-500	SO-192
Target	T3 (1.54:1)	T3 (1.54:1)
L/mm	147	145
Deviation $\bar{X}$	±1.2	±2.3
90% Confidence Interval $\bar{X}$	±2.0	±4.0
Target	T4 (2.18:1)	T4 (2.18:1)
L/mm	197	182
Deviation $\bar{X}$	±2.6	±2.2
90% Confidence Interval $\bar{X}$	±4.3	±3.8

As can be seen, the two products are essentially equal from the standpoint of resolution retention (approximately .5 Bar Group). The SO-500 appears slightly better in actual lines per millimeter (averaged) while the 90% confidence interval of SO-192 is narrower at the higher contrast.

D. CONCLUSIONS:

The results of the preliminary test program indicate that the [redacted] STAT Type SO-500 material is capable of resolution retention equal [redacted] STAT to that of SO-192 when applied to low contrast Tri-Bar Targets. Density uniformity is acceptable, well within the expected range of pilot coatings.

Determination of the sensitometric characteristics was impeded by a printer design deficiency. This resulted in higher than expected fog levels and possible degradation of the contrast characteristics. The problem is presently being corrected by the manufacturer. Processing gamma was low, approximately .90, accompanied by a maximum density of 2.0. Printer speed was limited to 5 feet per minute, about 1/20th that of the SO-192 production system. Based upon the favorable results of the resolution comparison, further testing will be performed when equipment modifications are completed. [redacted] will at that time provide an emulsion with higher gamma capabilities which should improve speed, Dmin, and Dmax. STAT

MEMORANDUM FOR: Wally –

Latest info from [redacted] STAT

Hank

7 Sept 1972
(DATE)

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PROJECT 325B

SUMMARY LETTER REPORT

PERIOD: July 1, 1972 to August 15, 1972

Submitted By: [redacted]

Project Manager

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[redacted]

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[redacted]

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PROJECT 325B

SUMMARY LETTER REPORT

PERIOD: July 1 to August 15, 1972

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Submitted By: [redacted]
Project Manager

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[redacted]

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SUMMARY

Project work this month has been concerned with continuing the forecast level of effort in Chemical, Engineering, QC/QA and Interface. A major portion of the work was given to designing and building the new darkroom, coating area and fabricating the hardware to outfit these darkrooms; sensitometers, coating stations and red light processors.

Recruiting was started to staff with additional coating technicians. The blend of senior chemical to technician personnel is changing to meet the six months project thrust.

Mass screening of chemical inhibitors continued and the combined chemical/overcoating methods for reduction of speed decay are underway.

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1.0 General

1.0.1 Personnel

In keeping with the projects need for more coatings, a number of adjustments in personnel have been made. Three new coating technicians have been added to Chemical R and D. They are:

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A fourth technician has been hired and will begin August 23. He is 25X1

Engineering has added a new coating technician and two mechanical technicians are due to be hired. The coating technician is Chemistry. 25X1

25X1 has been hired as a technician to assist in the QC/QA and Perkin Elmer Interface program.

As the new personnel have come on project, adjustments have been made with regard to senior personnel.

25X1 M.S. Chemistry, has been taken off project and 25X1 has been reduced to 50%. These adjustments are consistent with the reduced effort in synthetic work. will be directing his efforts to the 25X1 film coating and evaluation.

1.0.2 New Coating Area

Construction of the new coating facility has begun. Estimated completion date is September 15.

1.0.3 Final Report

The final report for the previous contract period (May to June, 1972) is in final preparation. Delivery should be about the middle of September.

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1.1 Chemical R and D

1.1.1 Inhibition of Speed Decay

Latest ingredient-interaction decay studies show complete stability in the absence of oxygen. Subsequent exposures to oxygen initiate decay.

The experimental details are consistent with the initial presence of peroxide/hydroperoxide or other types of decay initiators, but which are ineffective in the absence of oxygen, which is necessary to sustain an autoxidation decay mechanism. Subsequent decay on exposure to oxygen does not differentiate between inherent interaction with oxygen and peroxide/hydroperoxide initiated autoxidation. Future studies will include incorporation of effective peroxide decomposers as a means of differentiating these possibilities.

Studies with 5/D8 have reached a stage where this system must be considered as potentially superior to 5/D7. This can be seen from Figure 1 which compares typical RLD and DPO curves. RLD is not now optimum and preliminary studies indicate longer wavelength red light will be necessary than is the case for 5/D7. Preliminary decay studies suggest similar behavior to 5/D7 but blotching appears to be considerably less of a problem. Detailed decay, ingredient interaction, and overcoating studies are planned. Comparison of results to 5/D7 will provide a means of determining the role of the dye base in shelf life/speed decay.

An infrared method is being explored as a means of measuring the rate of loss of CBr_4 from film. Preliminary results indicate the method will work. Once the rate of CBr_4 loss can be measured attempts will be made to simulate both DPO and RLD decay curves by adjusting CBr_4 and 4DMAP concentrations. Successful simulation will strengthen the odds against a third, unrecognized decay mechanism and will also provide a rate for 4DMAP formation.

1.1.1.1 General Screening of Chemical Inhibitors

Triphenylamine (TPA) has been studied in formulas 5 and 5/D7 as a replacement for diphenylamine (DPA). The

results are encouraging. TPA also enhances speed and image densities, but, in contrast to DPA, it appears to retard rather than promote fogging. Speed decay properties are unchanged, however. Actual effects of this and all other materials on speed decay cannot be fully evaluated, however, until overcoating or other methods are used to inhibit loss of activator.

The effect of DSTDP on 5/D8 has been noted. It demonstrates similar though less dramatic results than observed with the 5/D7 system.

Fifty-seven peroxide decomposers have thus far been collected for screening. Of this number, twenty-three (23) have been synthesized (cf. 1.1.3.2); the rest have been purchased. Mass screening is expected to begin the first part of September, when the new coating technicians are up to speed.

1.1.1.2 Combined Chemical/Overcoating Methods

Examination of the sensitivity spots which are observed with overcoating reveals a crystal of D7 or 4PO, or a dust fiber at the center of each such spot. Close examination of dust fibers reveals the presence of small occluded crystals in each instance. This fact suggests that air-borne particulates are a cause of spot growth because of occluded or attached chemical ingredients, particularly the less soluble ones such as D7 or 4PO. Formulation adjustments including the use of a co-solvent to enhance ingredient solubility, replacement of 4PO by the more soluble N5 and replacement of D7 with the more soluble D8 (formula 5/D8) has resulted in nearly complete elimination of undissolved crystals. As a result, immediate overcoating of 5/D8 can now be accomplished without immediate onset of sensitivity spots. In fact, only a few random spots were observed in 19 hours at 70°C, and with no loss of DPO sensitivity.

The combination of chemical inhibitors with overcoating is scheduled to begin in early September. In the meantime, mechanical and physio-chemical methods are being studied as a means of extending the shelf-life of overcoated films.

1.1.2 Special Purifications

A sample of photograde D260 was repurified in the presence of DSTDP, a peroxide/hydroperoxide decomposer. Standard sensitometric film properties remained unaltered. This preliminary experiment indicates that the use of peroxide decomposers for individual ingredient purifications is feasible, and the next step will be to explore the effect of such purifications on speed decay.

1.1.3 Synthesis Program

1.1.3.1 D260 and Analogue

Both D260-carbinol (7 g) and the chloride dye of D260 (3 g) have been successfully synthesized. The final step in the alternate synthesis of D260 is chemical reduction of these final intermediates. If all goes well, enough D260 should be available for comparative evaluation of both sensitometric and speed decay properties.

1.1.3.2 Peroxide Decomposers

The syntheses of a number of commercially unavailable peroxide decomposers have been completed. The compounds synthesized include:

1) Six metal xanthates

2) Three Sulfoxides

3) The DSTDP and DLTDP oxides

4) Two thiosulfinates

5) Ten metal thiolthionophosphonates

1.1.4 Ingredient Purification and Supply Maintenance

All principal film ingredients are in adequate supply.

A total of 122 g of D8 has been synthesized for sustaining studies of 5/D8.

An order for another 5 kg of D260 has been placed with ChemSampCo.

1.1.5 Analytical Studies

Large scale chromatographic separation of normally light-exposed film products is underway. To date, 488 fractions have been collected. They indicate a relatively complex product mixture and the only products thus far identified are CBr_4 and 4-picoline. The CBr_4 indicates either incomplete fixing (most likely) or some form of physio-chemical retention (improbable). The presence of 4-picoline (10% of 4PO initially present) indicates oxygen-donation as at least a partial role for 4PO. First, however, 4-picoline (4P) must be shown to result from reactions in the film and not as an artifact from the chromatography.

Six dust samples collected from darkrooms have been analyzed by routine methods available at [redacted]. The results show occasional presence of such materials as D7, 4PO and D260. These results are consistent with the finding that dust in film coatings contain occluded or attached ingredient crystals (cf. 1.1.1.2). A daily clean-up procedure for darkrooms has been initiated. 25X1

FIGURE 1

Curve 1 - DPO

Exposure	$5.82 \cdot 10^{4}$
Te	300 seconds
Densities	(Wratten 93)
Step 1	1.90
2	1.90
3	1.82
4	1.62
5	1.18
6	0.82
7	0.50
8	0.26
9	0.16
10	0.09
11	0.06
0	0.06
Exp. No.	1825-34-7
Date	7/19/72
Development time (Tr)	-

Curve 2 - RLD

Exposure	17.8 mcs
Te	0.09 seconds
Densities	(Wratten 93)
Step 1	1.90
2	1.90
3	1.80
4	1.61
5	1.34
6	1.00
7	0.66
8	0.50
9	0.30
10	0.30
11	0.30
0	0.30
Exp. No.	1825-34-6
Date	7/19/72
Development Time (Tr)	41 seconds

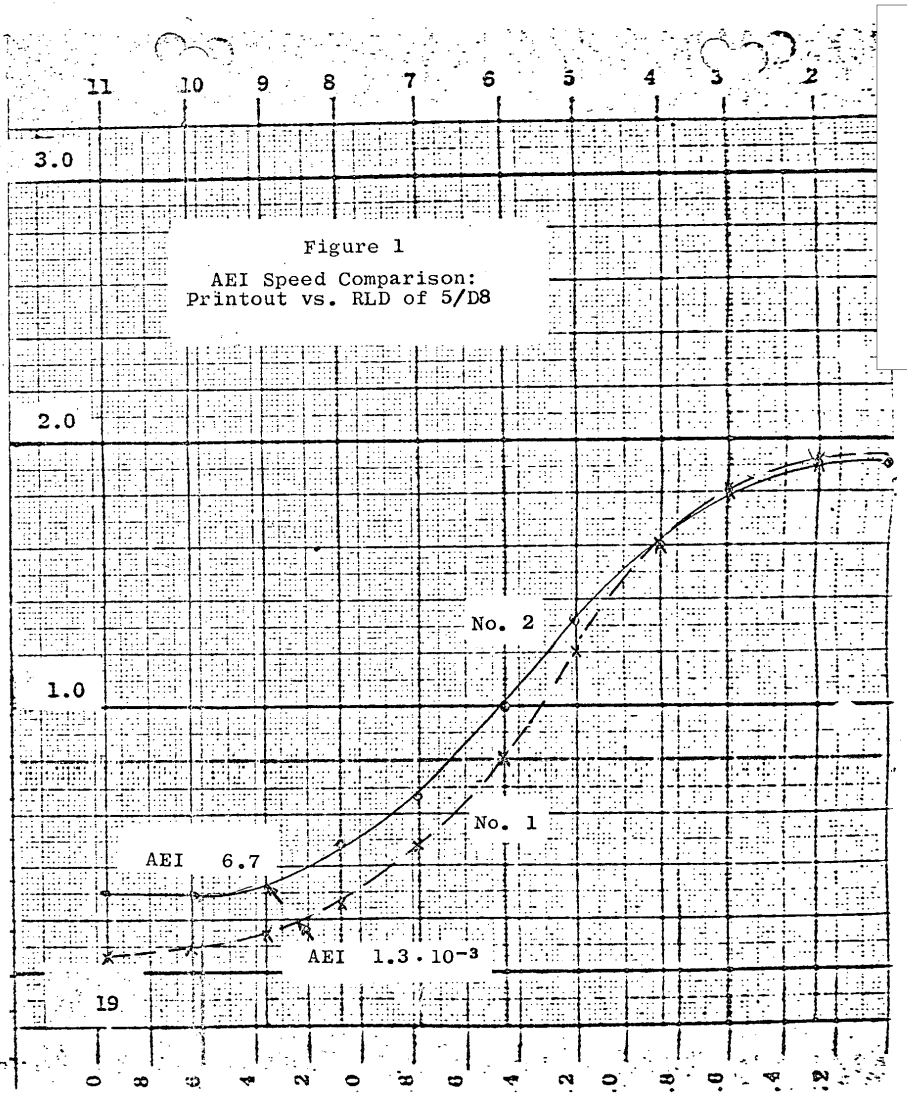

Figure 1

AEI Speed Comparison:
Printout vs. RLD of 5/D8

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		DOC Jul	Aug	Sep	Oct	Nov	Dec	EOC
1.1	Chemical R and D							
1.1.1	Inhibition of Speed Decay							
1.1.1.1	General Screening of Chemical Inhibitors							
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1.1.4	Ingredient Purification and Supply Maintenance							
1.1.5	Analytical Studies							

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1.2 Engineering

1.2.1 Calibration and Maintenance

This task is a continuing effort.

1.2.2 Supervision of New Darkroom Facilities

1.2.2.1 Design of Facilities

Facilities design is completed with construction underway.

1.2.2.2 Equipment Construction

Design and fabrication of laboratory hardware is continuing.

1.2.3 Shelf Life

1.2.3.1 Overcoating

The initial overcoating work was described in the customer briefing of July 6 and will be included in the final report of that contract period. At that point available mechanical means for inhibiting sensitivity spots appeared exhausted. Attention was turned to the polyvinyl alcohol (PVA) itself.

Several different PVA's have now been tested and several more remain to be tested. Prior to this testing, Elvanol 51-05 had been used exclusively. It now appears that Elvanol 52-22 as a 4-1/2% aqueous solution gives less sensitivity spots than 51-05 or the other recently tested ones.

Vinyl precoating, to serve as a moisture barrier between PVA overcoat and the photosensitive layer, has been briefly looked at. The results are encouraging!

Spin coating has been tried and looks promising. Currently, however, the spin coater is in an atmospherically uncontrolled area, where from previous experience films are known to deteriorate rapidly due to atmospheric contamination. The overall technique looks good however, and will be investigated further.

1.2.4 Red Lite

Red lite investigations continue with emphasis on "double" development.

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		DOC	Jul	Aug	Sep	Oct	Nov	Dec	EOC
1.2	Engineering								
1.2.1	Calibration and Maintenance								
1.2.2	New Darkroom Facilities								
1.2.2.1	Design of Facilities								
1.2.2.2	Equipment Construction								
1.2.3	Shelf Life								
1.2.3.1	Overcoating								
1.2.3.1.1	Overcoating Equipment								
1.2.3.1.2	Material Search								
1.2.4	Red Lite								
1.2.4.2	Filter Tests								

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1.3 Perkin Elmer Interface and QC/QA

1.3.1 Perkin Elmer Interface

1.3.1.1 Plans for Perkin Elmer Program

A copy of proposed plans have been submitted to the Customer (9 August 1972). This plan was agreed to by during his visit of August 4. 25X1

1.3.1.2 Liaison (Meetings)

A consultants meeting is scheduled for Monday, August 21, at the Perkin Elmer facility in Danbury. 25X1 personnel expected to attend are 25X1 25X1 will stay over Tuesday 25X1 to discuss interface work. Discussions will include chemical problems relating to interface and special facilities.

1.3.1.3 Film Shipments

Film Shipment 11 (first for this contract period) was sent 14 August which should be in time for lab work to be seen during the visit of 21-22 August.

1.3.2 QC/QA

The latest, updated purification procedures are currently being compiled. Photograde and crude materials inventory are now being monitored on a weekly basis.

Procedure for more vigorous daily darkroom cleanup are currently being established.

The D260-purification lab will be upgraded by installation of a plastic ceiling cover and a Barnebey Cheney unit.

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		DOC Jul	Aug	Sep	Oct	Nov	Dec	EOC
1.3	Perkin Elmer Interface and QC/QA							
1.3.1	Perkin Elmer Interface							
1.3.1.1	Test Planning for Perkin Elmer (RLD, Chamber, Redo's)							
1.3.1.2	Liaison (Meetings)							
1.3.1.3	Film Shipments							
1.3.2	QC/QA							

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PROBLEMS

1. Contractor delays in completion of new darkroom coating facility.

2. Securing best quality polyester base material.

PLANS FOR NEXT REPORTING PERIOD

1. Push for completion and qualification of darkroom coating facility.

2. Continue project work along forecast schedule.

FINANCIAL

Project is tracking within labor and materials budgets. See project tracking graphs.

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